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Electroglas Model 900 Automatic Wafer Prober

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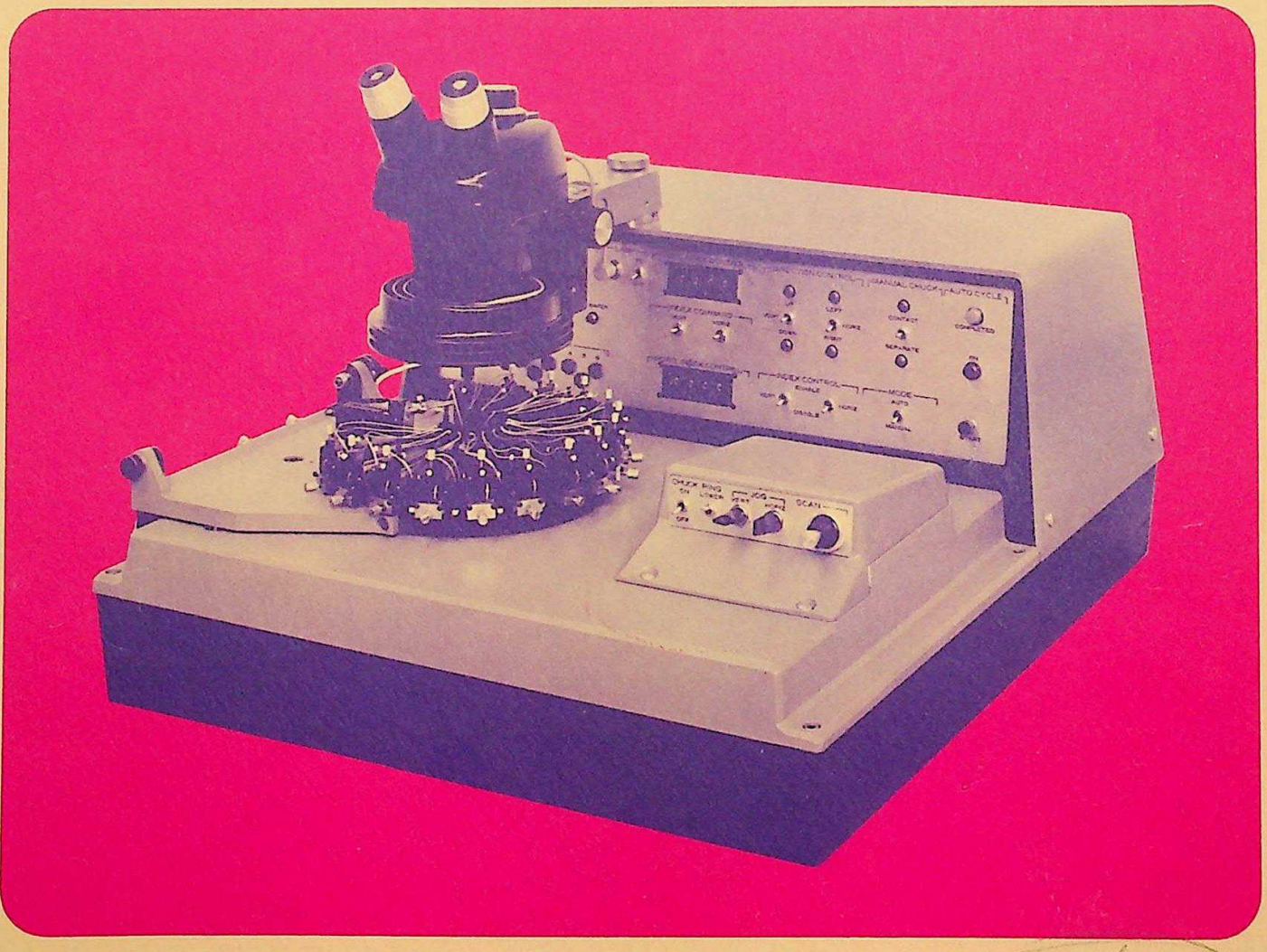
- Fully automatic operation at index speeds of up to 2.0 in/sec.
- "Human engineered" for rapid loading, alignment and operation
- Completely electronic sequencing
- Solid-state circuitry with 92% integrated circuits
- Optional inking systems for maximum flexibility
- Edge-sensing Wafer Profiler standard on all units
- Exclusive microscope illuminator for shadowless viewing

FOR SEMICONDUCTOR PRODUCTION



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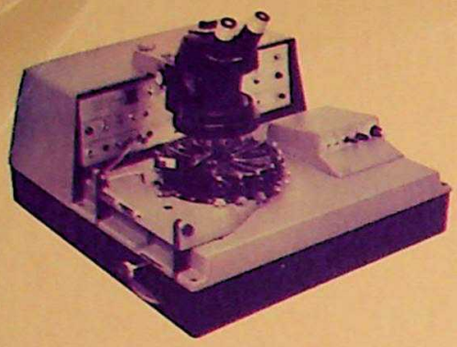


EXCLUSIVE STEPPING MOTOR CONTROL SYSTEM ACHIEVES UNPARALLELED INDEXING SPEED AND ACCURACY

The Electroglas Model 900 Wafer Prober is one of the most advanced machines ever designed for probing semiconductor devices in wafer form. Built by the makers of the world's first fully automatic prober, the Model 900 is the result of over six man-years of research and development.

The very high production speeds and probing accuracy of the machine can be traced to an exclusive technique for programming and control of the modified stepping motors used in the index drive mechanism. This patented system permits motor velocities never before achieved, yet solid coupling between the two motors and the X-Y wafer stage (through precision-ground lead screws) assures an indexing accuracy of ±.0001 inch/inch in both axes.

Electronically, the Model 900 incorporates one of the most sophisticated control logic systems ever used in a wafer probing machine. Sequencing is 100% electronic, and 92% of the machine's control circuitry employs reliable integrated circuits.

Despite its advanced design and remarkable performance, the Model 900 is a *production-oriented* machine—human engineered, with packaging innovations and operator convenience features found in no comparable instrument.

PROBING RATES—THOUSANDS OF DEVICES PER HOUR

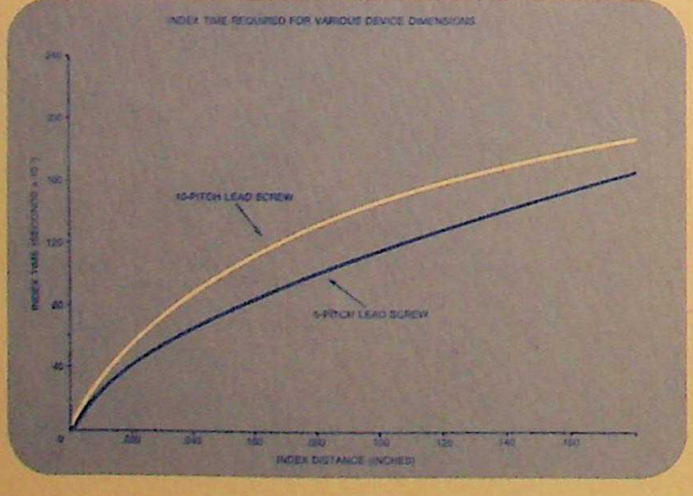
The five discrete steps which comprise the cycle of probing a semiconductor device all affect an automatic prober's rate of operation. With the exception of the testing interval, which is totally dependent upon the parameters programmed into an external test set, the Model 900 performs these steps faster and more efficiently than previous prober designs.

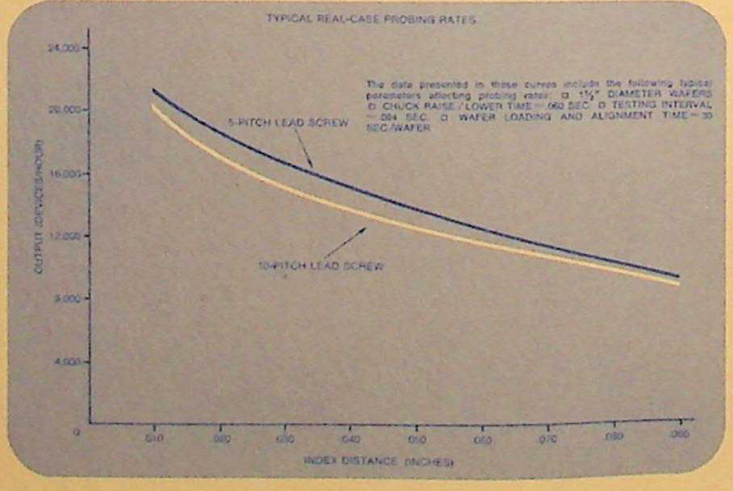
The first step in the cycle, Z-axis actuation of the vacuum chuck to raise the wafer into contact with the stationary probe points, is extremely important to a prober's overall speed. The chuck must rise as rapidly as possible, yet its intercept velocity at the time of probe/wafer contact must be precisely controlled to avoid damage to the wafer surface. Both requirements are met in the Model 900. The total time required for raising the chuck and returning it to its index position after the test interval is only .060 second—the fastest speed yet attained in this type of chuck mechanism. In addition, an adjustable damping unit built into the system allows the operator infinitely variable control of the intercept velocity.

The choice of reject inking systems described on page 4 can also be a factor in the Model 900's rate of operation. If in-place inking is used, inking occurs after testing and probe/wafer separation; this operation requires .050 seconds for each reject device. Delayed program inking, on the other hand, does not affect the machine's rate, since inking may occur either concurrently with the testing of another device, or immediately following the end of the test cycle and before separation takes place.

The X-Y indexing velocity of the Model 900 is the most significant aspect of its remarkable operating rate. The exclusive stepping motor control system permits extremely rapid acceleration and deceleration, without any sacrifice in indexing accuracy. The graph at the lower left shows this velocity profile at various indexing increments, for both 5- and 10-pitch lead screws, either of which is available at the customer's option. (See specifications, page 5.)

These features of the Model 900 produce a sizeable improvement in the speed with which any given semiconductor wafer can be probed. This absolute rate of operation, coupled with other design innovations that permit fast wafer loading and alignment, ease of control, and operator convenience, makes the total performance of the Model 900 quite remarkable. Real-case operating rates of between 8,000 and 21,000 devices per hour, as shown in the graph at lower right, are well within its capabilities.





GENERAL SPECIFICATIONS—MODEL 900 WAFER PROBER

Wafer Size Capacity:	2-inch diameter, maximum.
Probe/Inker Capacity:	Probe ring accommodates any combination of probes and inkers totaling 20. Standard units will mount a maximum of 6 inkers.
Indexing Range:	.0005 in. to .9995 in. (10-pitch lead screws). .0010 in. to .9990 in. (5-pitch lead screws).
Indexing Accuracy:	± .0001 in./in.
Indexing Drive:	Modified stepping motors, coupled to X-Y stage by precision-ground lead screws.
Scanning System:	Multi-directional (joystick) scanning with automatic direction memory and over-ride. Dual scanning speeds (2.0 in./sec., 0.35 in./sec.). Dual-function jog switches (X and Y) with option of single-step or pulsating jog (variable from 1 to 100 steps per second).
Bench Space Required:	25 x 22 inches.
Weight:	190 pounds (approximate).
Utilities Required:	110-125 VAC, 50-60 cps, 1-phase @ 1.25 KW, 12-15 in./min/Hg vacuum, 40-80 psi air pressure.
Optics:	B & L Stereo Zoom microscope (40X-60X). Equipped with I-96 Illuminator. (Optional stereo microscopes with up to 150X magnification.)
Manual Control:	Remote manual control of stepping advance and inker actuation is optional.

INTEGRATED CIRCUIT ELECTRONICS PROVIDE HIGH RELIABILITY, EASE OF SERVICE

The control electronics of the Model 900 Prober are housed in a swing-out integral card cage containing plug-in printed circuit boards. 92% of these controls utilize reliable DTL integrated circuits. All transistors are of the silicon planar type, 50% derated. Sequencing is 100% electronic and does not depend on cams, microswitches or other mechanical components with high failure rates.

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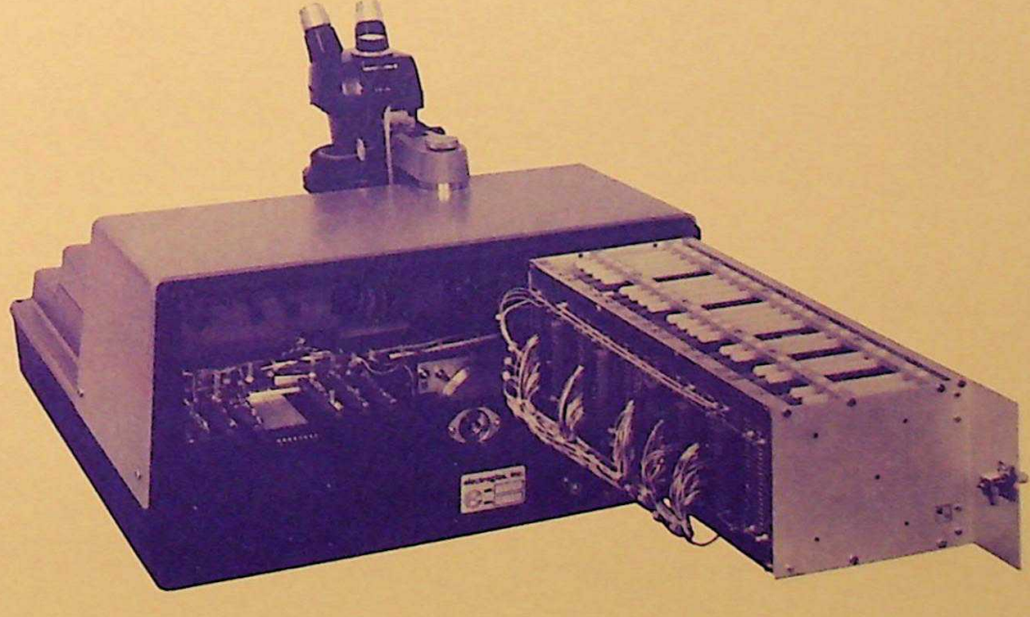


HUMAN ENGINEERING ASSURES MAXIMUM OPERATOR EFFICIENCY

CONVENIENT LOADING AND ALIGNMENT

Wafer loading and alignment become more and more important as probing speeds increase. During any period of time, the operator must change wafers more often. This is particularly significant with smaller wafers and with wafer patterns of low device density.

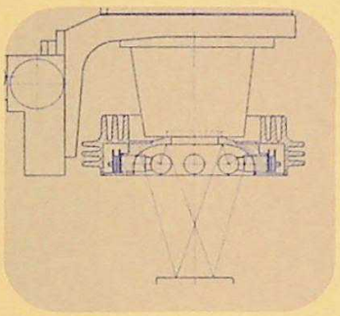
A number of exclusive features of the Model 900 make it possible for an experienced operator to set up a wafer in the machine in less than 30 seconds:

- A scanning speed of 2.0"/sec permits faster alignment.
- The probe ring and microscope both swing away from the chuck area for convenient access during loading. The ring raises automatically to 35° when the scope is pivoted away (photo shows ring in its 90° rest position).
- Rotational alignment of the chuck is controlled by a small, easily manipulated knob near the operator's left hand. This control operates through 360° with a resolution of one second of arc!
- During alignment, stage scanning can be directed in eight directions by use of a single multi-purpose command switch.
- Jog controls, mounted next to the scanning switch, allow the operator to control jog in either axis, continuously or in single steps.
- All probe point adjustments are easily accessible on the periphery of the ring assembly.

This combination of design features precludes the need for an expensive "prealignment station" for rotationally aligning wafers in advance. Typical alignment intervals of 20-30 seconds are quite common with the Model 900. The resulting cost saving is substantial.

EXCLUSIVE MICROSCOPE ILLUMINATOR

All Model 900 automatic probers are equipped with an Electroglas-designed I-96 Microscope Illuminator, shown in the drawing at right. This four-bulb illuminator completely eliminates the distracting shadows often encountered during probe set-up and wafer alignment. The bulb placement and reflector design assure that every point on the wafer surface is illuminated by a scatter-pattern of light, minimizing shadows and providing constant light intensity over the viewing field. The operator can vary the illuminator's brightness by means of a conveniently located dimmer control knob.



WAFER PROFILER ELIMINATES OFF-WAFER CYCLING

An improved edge-sensing system, the Wafer Profiler, is now standard equipment on all Model 900 probers. This automatic system controls the prober's indexing pattern to eliminate "waste" probing of areas beyond the periphery of the slice being tested. One or more Model 251-PL edge-sensing probe heads are used to identify the wafer edge and send a command signal to the Profiler's logic circuitry. Changes in indexing direction after this command is received can be programmed in advance to delay from zero to seven steps before changing rows and reversing direction; this feature assures that all devices on partial or broken wafers will be tested. The system also locks out the external test set automatically as soon as an off-wafer condition is sensed, preserving the accuracy of the probing total recorded by the test set counter. The machine stops automatically after 10 consecutive off-wafer cycles.

By converting the prober's normal square indexing pattern to one more nearly approximating a circle, the Wafer Profiler saves approximately 25% of the prober's unnecessary cycling, even on undamaged wafers. Time conserved on partial wafers is often more dramatic.

OPTIONAL INKING SYSTEMS

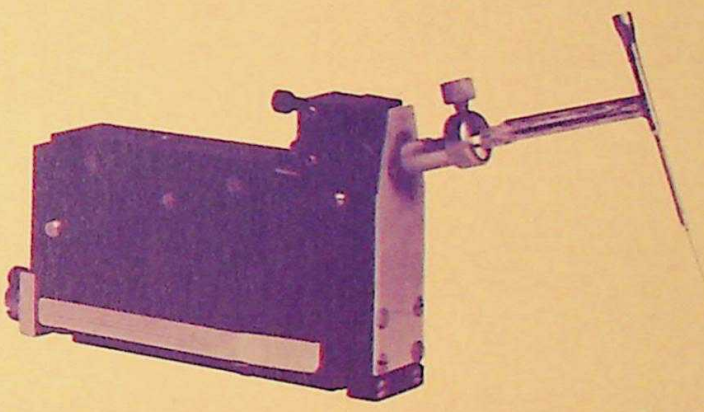
STANDARD "IN-PLACE" INKING. As mentioned in the discussion of probing rates, the standard automatic inking system on the Model 900 adds 50 milliseconds to the probing cycle each time a device must be inked.

DELAYED PROGRAM INKING. In some instances, it is necessary, due to physical size requirements, to delay the inking of a device until after the wafer stage has indexed to an adjacent device. This method completely isolates the inking interval from the prober's total cycling time; it also permits less difficult multi-ink classification of smaller or more complex devices. The E-91 Delayed Program Inking accessory allows this inking method to be used with the Model 900. No major modification to the prober is required. A simple exchange of two printed circuit cards is the only requirement.

The E-91 inking accessory contains all necessary memory and control circuits to guide three inking channels in a delayed program mode. This enables up to three different ink colors to be used, even on very small, complex devices. Each inker can be programmed to actuate from one to four steps behind the active probing cycle.

Provisions for monitoring up to three edge-sensing probe heads are also included in the E-91's circuitry. This feature produces a more efficient probing program along wafer edges and facilitates the automatic probing of several devices per cycle.

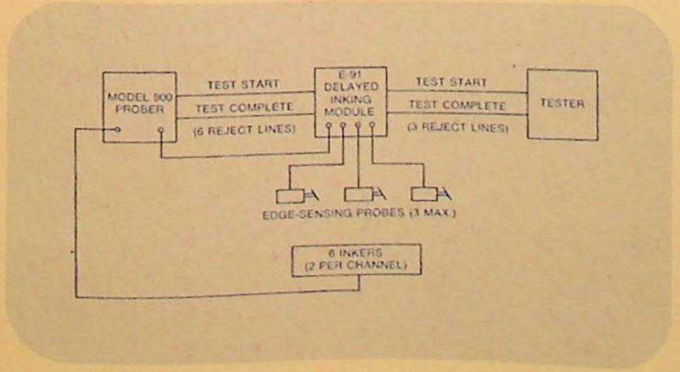
The block diagram below shows a simple schematic of the interfaces between the Model 900 Prober, the E-91 inking module and the external test set.



AUTOMATIC INKERS MODEL 390

New Electroglas Model 390 automatic inkers are used on the Model 900. Easily adjustable to any position within a 1/8-inch cubic matrix, these high-speed solenoid-operated inkers contribute substantially to the prober's performance. Their slim profile makes them ideal for in-place inking. In fact, up to six pens can actually be positioned to sequentially mark the same spot on a wafer without interference. Only .050 second is required for the inking cycle.

Two pen sizes can be used with the 390 inker—an Electroglas Microdot pen, which deposits an ink dot only 4 mils in diameter, and a larger 10-mil pen. Special Leroy adaptors also are available for larger sized dots.



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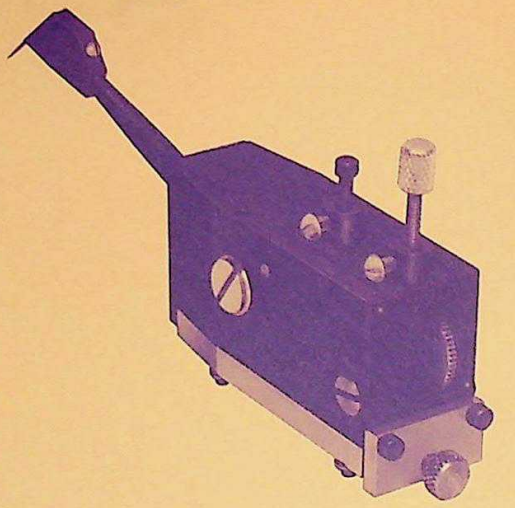

PROBE DESIGN FEATURES

MODEL 251

All Model 900 Probers are equipped with Model 251 Probe Heads, a new, ruggedized design, proven on previous Electroglas probing equipment. Although very easy to adjust and planarize, the probe's position and pressure controls are locked in place by nylon set screws to prevent adjustment changes during continuous use. Precision, adjustable-pressure ball bearings are used in the arm pivot to assure proper tension and ease of positioning. Device damage due to point scrubbing can be eliminated completely with the 251 Probe, the only probe with tension adjustable to as low as 2 grams (range: 2-18 grams).

MODEL 251-PL

One or more reliable Model 251-PL Probe Heads are used on the Model 900 to sense wafer edges and transmit command signals to the Wafer Profiler system. Unlike most conventional edge-sensing probes, the 251-PL does not depend on strain gauge impulses to identify an off-wafer condition. A precision microswitch within the probe body, actuated mechanically by the relative change in elevation of the probe point, is used instead. This sensing method is far more dependable than strain-gauge systems and assures accurate operation of the Wafer Profiler on differential thicknesses of material as small as .002 inches.

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